

## **CLAIMS**

### **What Is Claimed Is:**

1. An apparatus for actuating a control surface, comprising:  
a first spur gear;  
5 a first drive assembly engaged with the first spur gear;  
a second spur gear;  
a second drive assembly engaged with the second spur gear; and  
a gear assembly mechanically capable of being coupled with the control surface and  
engaged with the spur gears.

2. An apparatus, according to claim 1, further comprising a central tube and a  
bearing disposed between each of the spur gears and the central tube.

3. An apparatus, according to claim 2, wherein the central tube comprises a blast  
15 tube.

4. An apparatus, according to claim 2, further comprising a housing and a thrust  
bar mounted to the housing and to the central tube, such that one end of the gear assembly is  
mounted to the thrust bar.

5. An apparatus, according to claim 1, wherein at least one of the drive  
assemblies further comprises:

a motor;

a speed reducer mounted to the motor and having an output shaft; and

a drive gear mounted to the output shaft and engaged with one of the spur gears.

6. An apparatus, according to claim 1, wherein the gear assembly comprises:

a first screw;

5 a first gear engaged with the first spur gear;

a thrust nut mounted to the first gear and threadedly engaged with the first screw;

a second gear engaged with the second spur gear;

a second screw mounted to the second gear and mechanically coupled with the thrust nut such that the second screw and the thrust nut rotate independently and translations of the

10 thrust nut are transmitted to the second screw;

a translation nut threadedly engaged with the second screw and capable of being mechanically coupled with the control surface.

7. An apparatus, according to claim 6, wherein:

15 the translation nut comprises a clevis; and

the apparatus further comprises a linkage mechanically coupled with the clevis and capable of being coupled with a clevis of a control surface shaft.

8. An apparatus, according to claim 6, wherein the first screw is adapted for

20 adjusting the gear assembly.

9. An apparatus, according to claim 1, wherein the first spur gear comprises a roll spur gear and the second spur gear comprises one of a pitch spur gear and a yaw spur gear.

10. An apparatus, according to claim 1, wherein:

the translation nut comprises a clevis; and

the apparatus further comprises a linkage mechanically coupled with the clevis and

5 capable of being coupled with a clevis of a control surface shaft.

11. An apparatus, according to claim 1, further comprising:

a third spur gear;

a third drive assembly engaged with the first spur gear; and

10 a second gear assembly mechanically coupled with a second control surface and  
engaged with the first spur gear and the third spur gear.

12. An apparatus, according to claim 11, wherein the first spur gear is a roll spur  
gear, the second spur gear is a pitch spur gear, and the third spur gear is a yaw spur gear.

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13. An apparatus, according to claim 11, further comprising an actuation  
controller coupled with the drive assemblies, such that actuation commands may be  
transmitted from the actuation controller to the drive assemblies.

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14. An apparatus, according to claim 1, further comprising an actuation controller  
coupled with the drive assemblies, such that actuation commands may be transmitted from  
the actuation controller to the drive assemblies.

15. A vehicle, comprising:

a control surface; and

an apparatus for actuating the control surface, comprising:

a first spur gear;

a first drive assembly engaged with the first spur gear;

5 a second spur gear;

a second drive assembly engaged with the second spur gear; and

a gear assembly mechanically coupled with the control surface and engaged  
with the spur gears.

10 16. A vehicle, according to claim 15, further comprising a central tube and a  
bearing disposed between each of the spur gears and the central tube.

17. A vehicle, according to claim 16, wherein the central tube comprises a blast  
tube.

15 18. A vehicle, according to claim 16, further comprising a housing and a thrust bar  
mounted to the housing and to the central tube, such that one end of the gear assembly is  
mounted to the thrust bar.

20 19. A vehicle, according to claim 15, wherein at least one of the drive assemblies  
further comprises:

a motor;

a speed reducer mounted to the motor and having an output shaft; and

a drive gear mounted to the output shaft and engaged with one of the spur gears.

20. A vehicle, according to claim 15, wherein the gear assembly comprises:

a first screw;

a first gear engaged with the first spur gear;

5 a thrust nut mounted to the first gear and threadedly engaged with the first screw;

a second gear engaged with the second spur gear;

a second screw mounted to the second gear and mechanically coupled with the thrust nut such that the second screw and the thrust nut rotate independently and translations of the thrust nut are transmitted to the second screw;

10 a translation nut threadedly engaged with the second screw and mechanically coupled with the control surface.

21. A vehicle, according to claim 20, wherein:

the translation nut comprises a first clevis;

15 the control surface comprises a shaft including a second clevis; and

the apparatus further comprises a linkage mechanically coupling first clevis and the second clevis.

22. A vehicle, according to claim 20, wherein the first screw is adapted for

20 adjusting the gear assembly.

23. A vehicle, according to claim 15, wherein the first spur gear comprises a roll spur gear and the second spur gear comprises one of a pitch spur gear and a yaw spur gear.

24. A vehicle, according to claim 15, wherein:

the control surface comprises a shaft including a first clevis;

the gear assembly comprises a second clevis; and

the apparatus further comprises a linkage coupling the first clevis and the second

5 clevis.

25. A vehicle, according to claim 15, further comprising:

a third spur gear;

a third drive assembly engaged with the first spur gear; and

10 a second gear assembly mechanically coupled with a second control surface and  
engaged with the first spur gear and the third spur gear.

26. A vehicle, according to claim 25, wherein the first spur gear is a roll spur gear,  
the second spur gear is a pitch spur gear, and the third spur gear is a yaw spur gear.

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27. A vehicle, according to claim 25, further comprising an actuation controller  
coupled with the drive assemblies, such that actuation commands may be transmitted from  
the actuation controller to the drive assemblies.

20 28. A vehicle, according to claim 15, further comprising an actuation controller  
coupled with the drive assemblies, such that actuation commands may be transmitted from  
the actuation controller to the drive assemblies.

29. A method for actuating a control surface, comprising actuating the control surface in response to an actuation of at least one of a first spur gear and a second spur gear.

30. A method, according to claim 27, wherein actuating the control surface further comprises translating a thrust nut along a first screw in response to an actuation of the first spur gear.

31. A method, according to claim 27, wherein actuating the control surface further comprises translating a translating nut along a second screw in response to an actuation of the second spur gear.

32. A method for actuating a control surface, comprising mechanically combining two inputs into a single mechanical output to the control surface.

33. A method, according to claim 32, wherein mechanically combining the two inputs comprises mechanically combining a roll input and a pitch input.

34. A method, according to claim 32, wherein mechanically combining the two inputs comprises mechanically combining a roll input and a yaw input.

35. An apparatus for actuating a control surface, comprising means for mechanically combining two inputs into a single mechanical output to the control surface.

36. An apparatus, according to claim 35, wherein the means for mechanically combining the two inputs comprises means for mechanically combining a roll input and a pitch input.

5 37. An apparatus, according to claim 35, wherein the means mechanically combining the two inputs comprises means for mechanically combining a roll input and a yaw input.